Faculty Working Papers

DETERMINANTS OF URBAN
UNEMPLOYMENT DIFFERENTIALS

R. Christopher Lingle
and C. F. Sirmans

#365

College of Commerce and Business Administration
University of Illinois at Urbana-Champaign

FACULTY WORKING PAPERS

College of Commerce and Business Administration

University of Illinois at Urbana-Champaign

January 4, 1977

DETERMINANTS OF URBAN UNEMPLOYMENT DIFFERENTIALS

R. Christopher Lingle
and C. F. Sirmans

#365

DETERMINANTS OF URBAN UNEMPLOYMENT DIFFERENTIALS

R. Christopher Lingle
Department of Economics
West Georgia College

and

C. F. Sirmans*
Department of Finance
University of Illinois

*Research support from the Illinois Business Associates is gratefully acknowledged. The authors wish to thank Dr. Ethel B. Jones for inspiration. The usual disclaimer applies.

DETERMINANTS OF URBAN UNEMPLOYMENT DIFFERENTIALS

I. Introduction

Although many problems of urban economies have been explored extensively in the literature, no effort to date has appeared which addresses the determinants of spatial unemployment differentials in the United States.[1] The purpose of this paper is to fill this gap in the literature by specifying and testing a model of inter-urban unemployment differentials. Specifically, this study examines urban unemployment in the continental United States using the Standard Metropolitan Statistical Areas (SMSA's) as the unit of spatial aggregation. The variations in male and female unemployment rates from the 1970 Census of Population are explained by a model estimated using Zellner's seemingly unrelated regression (SUR) technique.

Several previous studies have indicated the importance of socio-demographic characteristics of the labor force as important factors in determining variations in urban unemployment rates (Hall [1972]; Perry [1972]). Recently these models have been expanded to include area characteristics as unemployment determinants and tested empirically relying upon British data (Vipond [1974]; Metcalf [1975]). The influence of size and types of cities on United States unemployment figures has also been neglected in the literature. Investigation of the influence of city size upon unemployment

is supported by the assumption that economies of scale have an impact on the mechanisms of the urban labor market (Richardson [1973]; Vipond [1974]). The impact of economies of scale is expected since it is generally recognized that population agglomeration results because (i) there are technological economies of scale in both production and consumption and (ii) these activities are neither space nor land intensive. Further, "scale economies may occur at the final output level, at the marketing level, or at the intermediate input level, such as in transportation systems or capital and labor market-development" (Henderson [1974]).

It has been traditionally argued that large cities tend to show more favorably than small cities on most major economic variables such as income levels, income dispersion, or poverty indices.[2] Richardson has recently proposed that unemployment is a possible exception to the rule and, although three broad hypotheses are presented concerning the relationship between unemployment and city size, he notes that "... the evidence is not clear, but certainly there are few indications to support the plausible hypothesis of an inverse relationship between unemployment and city size" ([1973], p. 60). This paper represents the first attempt at estimating a model of urban unemployment differentials and tests extensively the relationship between city size and economies of scale in the urban labor market. The second section develops the model of spatial unemployment differentials which is estimated and discussed in section III. The final section contains some brief concluding comments.

II. A Spatial Model of Unemployment Differentials

It has been established that a persistent geographical dispersion in unemployment exists across cities in the United States (Hall [1970, 1972]). Variations in labor market characteristics, demographic composition of the labor force, skill levels attained by and required of the local work force and other factors are suggested as contributing to the differentials in unemployment reported for each respective market. The model proposed in this paper includes labor market variables, both spatial and economic, and socio-demographic variables. All of these variables interact within the labor market environment and influence the search and employment horizons for employers and workers.

An important aspect of the model proposed in this paper is the recognition that differences exist in the functioning of labor markets for male and female work force. Acknowledging that male and female workers are not perfect substitutes at the margin, a sexually disaggregated model is proposed, thereby avoiding a specification bias which would arise from estimating a model of total unemployment.

Unemployment statistics can be viewed as the outcome of labor market turnovers and the duration of a spell of unemployment. Turnover and duration, on the other hand, also have been established as important determinants for disparities in unemployment among and within groups of workers (Smith, Vanski, and Holt [1974]). Significant differences in, say, labor force characteristics across cities, can therefore contribute to differentials in unemployment since they offset

turnover rates and duration. Economies of scale associated with a given urban area can similarly impede or improve prospects of successful job search. Conditions of the local economy reflected by industry mix and the general economic health of the area also influence the employment status of the local labor force.

Labor Market Variables

Use of standard metropolitan statistical areas as the unit of observation follows the premise that local labor market conditions are a crucial element in the determination of unemployment. Also, the selection of the SMSA's allows for the assumption that the tastes of individual, for example, towards job search and the willingness to commute, are similar. On the demand side, employer's manpower needs and hiring practices, and perhaps attitudes toward discrimination, are made homogeneous by confining attention to SMSA's.

A. Industrial Mix: The structure of the industrial mix of an area has at least two separate influences upon area unemployment. First, if employment concentrates in a sector which is insulated from cyclical maladjustments or which is less sensitive to changes in the cycle, the area should, *ceteris paribus*, have lower unemployment figures. On the other hand, if total employment involves a high proportion of jobs which are likely to be held by one group or another, lower unemployment rates for that group will likely be the result. In the case of female workers, the presence of a high percentage of sex-stereotypical jobs open to women may also

signal a healthy local economy due to the service oriented nature of so-called female jobs, suggesting lower unemployment rates for males as well.

Two independent variables were chosen to measure industry mix: the percent male and female labor force employed in manufacturing and the percent employed as white collar workers. Although conflicting theoretical arguments and conflicting empirical interpretations, using approximately the same data, have been offered for the predicted relationship between the unemployment measure in a city and the share of employment in manufacturing (compare Vipond and Metcalf), the traditional export theory of urban growth provides a framework for a defensible hypothesis. It has been traditionally argued that basic industry, like manufacturing, is the impetus to growth. The development of a favorable industry mix in turn creates demand for labor talents in the secondary or non-basic industries. With the more favorable industrial structure, indicated by the proportion of employment that is concentrated in manufacturing, the more favorable the employment status of the local labor force and the lower would be the unemployment rate.

White collar workers are typically management and professional workers. A concentration of this group of workers should indicate that a more stable economic base is present to support this class of workers. Although it might be maintained that, since the majority of these workers can be expected to be male, the impact will be isolated upon male unemployment. However, this group of workers is probably more

inclined to consume services leading to greater employment opportunities for females. Hence, an inverse relationship is anticipated to exist between the proportion of white collar workers and male as well as female unemployment rates.

B. Spatial Characteristics: Spatial characteristics of urban labor markets are captured by the density of the population per square mile and the percentage of the labor force working in their county of residence. The unemployment rate in a SMSA can be viewed as a combination of unemployment in the urban and suburban populations. Unemployment in the central city generally tends to be higher than that of suburban residents since there tends to be a greater concentration of large numbers of poor. The greater the population density the more highly "urban" than suburban the character the SMSA area. Hence, other things being equal, it is hypothesized that the more highly "urban" is an SMSA, as measured by population density, the higher will be unemployment.

The spatial dispersion of job opportunities is measured by the percent of the labor force working in their county of residence. The journey to work literature has traditionally argued that groups with higher unemployment rates, for example, blacks and females, will tend to live nearer their place of employment. Thus, it is expected that the commuting variable will have a positive impact on unemployment rates.

C. Size and Region: Factors on both the supply and demand sides can be identified which would be expected to

vary systematically with city size. The influence of economies of scale in the labor market is captured by the size variable. Larger markets can produce beneficial economies since they offer a greater choice to both workers and employers which, by reducing the search time, results in lower unemployment. As the size of the market increases, diseconomies might also possibly arise from the difficulties of communication between those seeking work and employers. The a priori influence of size on unemployment is thus indeterminant.

Total population is employed in this paper as a measure of the possible city size effect. Rather than the use of a single population variable, dummy variables are employed since the possible size effect may well be discrete non-continuous and non-monotonic in nature. The SMSA's are categorized into six size groups: 2 million and greater; 1 to 2 million; 500,000 to 1 million, 250,000 to 500,000; 150,000 to 250,000; and 50,000 to 150,000. The influence of the size effect may well not be the same across size categories as a result of the lack of homogeneous economic character. The use of dummy variables removes possible specification bias which would be caused by using the total population as a continuous variable.

The unemployment rate might also be expected to vary across geographic regions. This region variation is captured by the use of dummy variables with the regions defined according to the nine Census geographic divisions. These dummy variables account for differences in labor markets across geographic regions. For example, regions of rapid

growth or stable demand for labor, ceteris paribus, should have lower unemployment rates. On the other hand, regions with a large influx of migrants in the absence of expanding employment opportunities can be expected to have relatively higher unemployment. It is hypothesized that there is a residual variation in unemployment from region to region which is not accounted for by the other variables in the model which is measured by the use of the region's dummy variables.

Socio-Demographic Variables

The impact of demographic variations upon unemployment differentials is transmitted through differences in duration and frequency of unemployment of particular groups. Age and racial distribution of the population are commonly cited factors which give rise to variations in the labor market behavior of workers in a given area. Educational attainment and the acquisition of marketable skills are also important demographic factors in the determination of the employment status of a particularly defined labor force. Acquiring skills and attaining credential levels in formal education (high school or college degrees, for example) are usually associated with workers that are less likely to be laid off or to quit a job, hence, less likely to become unemployed.

A. Education and Training: In order to test the impact of formal schooling and skill acquisition upon unemployment, two variables were included in the model: the median years of school completed by the male and female

population which was 16 years and older and the percent of the male and female labor forces which have completed vocational training programs. Employers often use educational attainment as a convenient screening device for prospective applicants. Applicants with more schooling will be hired more readily, thus spending less time in an unemployed state and will probably not be laid off. On the other hand, continued investment in formal schooling probably indicates the decision has been made to pursue a career. These workers will quit in most cases only to move to a better job. The more educated workers in most cases can be expected, therefore, to have fewer and shorter spells of unemployment.

Human capital investment theory likewise predicts that workers receiving training, particularly in firm-specific skills, will be less vulnerable to layoffs. Vocational training should also serve as an indicator of a more serious and stable worker, less likely to quit a job unless another job awaits. Workers completing vocational training programs should act in a similar manner as those receiving formal schooling. Higher percentages of both these variables should lead to lower unemployment rates in the absence of changes in the other independent variables.

B. Racial Distribution: The influence of the racial mix of a population upon unemployment is generally explained by acknowledging the characteristically higher unemployment rates for non-white workers. The effects of race discrimination account for reduction in the opportunities of non-white workers for schooling, hiring, promotion, acquisition of training, and

receipt of wages. Demand considerations based upon direct and indirect discrimination and inferior educational background lead to a worker that is more likely to be laid off and less likely to be promoted or to receive job-specific training. Non-white workers, consequently, are restricted to jobs which lead to relatively greater frequencies of unemployment and require that more time be spent in job search.

Evidences of extended duration and frequent spells of unemployment lead to an expectation of a positive association between the percent of non-whites and unemployment. The influence is captured by the percent of the male and female labor force which is non-white.

C. Age Distribution: Concentrations of workers at either extreme of the age distribution will influence unemployment to the extent that younger and older workers can be expected to have different labor market experiences than prime-age workers. Two variables were selected to indicate the percentage of workers not in the prime-age category: the percent of the male and female population who were between 18 and 24 years of age and the percent male between 55 and 64 and percent female between 45 and 64.[3]

Younger workers, particularly those in their teens, are more inclined to enter the labor market frequently in order to test the market. By doing so, they gain experience which is available by no other means. Perry [1972] presents evidence that the frequency of job search is greater for teenagers than adults, but that duration of unemployment is slightly less as a consequence of the lack of unemployment

opportunities and the greater likelihood that teenagers will withdraw from the labor force. These teenaged workers, responding to school ties, rising family incomes, and more appealing alternatives to labor force participation, are finding it less necessary and less attractive to be permanently attached to the labor force. The tendency to drop out of the labor force when they experience unemployment and the trend for young people to remain in school longer lead to an expectation that the teenagers remaining in the labor force will be gainfully employed. This further leads to the expectation that relatively larger younger labor force figures will be associated with lower unemployment rates in the model.

Workers approaching legal retirement age begin to face changing circumstances. Job loss at an advanced age becomes more critical, since an involuntary separation will result in the expectation of an extended duration of unemployment. Superannuated skills or lack of appropriate skills combined with the prospect of age discrimination reduces the variety of job prospects and the possibility of acquiring a high paying job. While the training of an older worker is likely to be specific in nature and thus rather useless to other employers, even the general training received at an earlier age will probably be obsolete, leading to higher unemployment.

However, the low probability of securing employment and a decline in the expected wage will result in lowering the returns to job search and may encourage withdrawal from the labor market. This behavior will necessarily lead to a

reduction in measured unemployment. Therefore, the combination of lower quit propensities of mature workers and the expected withdrawal of unemployed workers reaching retirement age support the hypothesis that relatively high proportions of older workers should lower measured unemployment rates of either sex. The expected influence of the older age variable is thus hard to determine, a priori.

Model

The model of urban unemployment differentials can be expressed as:

$$U_i = f(\text{Den, Com, Ed, \%VT, \%Mfg, \%WC, \%BLF, Age1, Age2, Size, Div, random errors})$$

where:

U_i = unemployment rate in the i^{th} SMSA (i = 1, 242) for males or females in 1970,

Den = population density per square mile,

Com = percent of the work force living and working in the same county,

Ed = median years of education for males and females,

%VT = percentage of the male and female labor force with vocational training,

%Mfg = percent of the male and female labor force employed in manufacturing employment,

%WC = percent white collar workers,

%BLF = percent of male and female labor force which is non-white,

Age1 = percent of male and female population in the young age group,

Age2 = percent of male and female population in the old age group,

Size = population size dummies, and

Div = geographic region dummy variables.

All of the data were taken from the 1970 Census of Population. The following section provides a test of this model.

III. Empirical Analysis

Techniques

In testing the model, separate equations for male and female unemployment were estimated using a multiplicative form in which the variables are transformed into double-log expressions. Thus, the estimated coefficients are directly interpretable as elasticities. The usual caution of causality and association should be kept in mind by the reader.

Given the delineation of the model into two equations defined by sex, estimation using ordinary least squares (OLS) can be ruled out upon econometric grounds, since OLS fails to take into account the probable existence of disturbance correlation between the equations. Another potential problem is that the SMSA's differ greatly in population size so that the assumption that each equation possesses a homoscedastic error term is doubtful. The variance for a particular observation was found to be related to the size of the male and female population for each of the estimated equations. This problem was mitigated by transforming each observation by dividing each variable by the square root of each of the appropriate populations and then regressing on the transformed data. The resulting equations are equivalent to weighted least squares regression (WLS).[4]

Zellner's seemingly unrelated regression (SUR) technique, in addition to the OLS and WLS, was also applied to the set of transformed data.[5] Use of SUR is appropriate when the specification of a set of regression equations is such that certain commonly correlated variables are excluded. When this occurs and if the dependent variables are somehow correlated (the simple correlation coefficient for male and female unemployment in the sample is .58), the disturbance terms of the system of equations will be contemporaneously correlated. Correlation of the residuals of a set of equations is a necessary but not sufficient condition for SUR to afford an improvement in the estimators in the equations.

Regression estimators derived from SUR under the above conditions are asymptotically more efficient than estimators derived from an equation-by-equation application of OLS, i.e., the variance of the coefficients estimated by SUR is reduced. The gain in efficiency exhibited by SUR estimated regressors is directly related to the residual correlation and inversely related to the correlation between distinct explanatory variables across equations.[6] The estimated disturbance correlation between the male and female unemployment equations (.60) implies that SUR might be appropriate. The transformation of the data by the weighting scheme yields distinct regressors that possess simple correlation coefficients of less than .70 for most variables which further supports use of SUR. Therefore, SUR is a desirable and statistically sound econometric technique which should yield more efficient

estimates of the equations than either the OLS or the WLS. The SUR technique is also attractive since F-statistics for testing significant differences in estimated coefficients across equations are a by-product of the analysis.[7] In light of the improved estimators provided by the seemingly unrelated regression technique, they are the only set to be discussed. Table I contains the Zellner estimates and associated F-statistics for the model after it has been corrected for heteroscedastic disturbance for the male and female unemployment rates.

Results

The WLS regression estimates explain a substantial proportion of the variation in SMSA male and female unemployment rates. The adjusted coefficients of determination ($\bar{R}^2$s) are .81 and .58 for the male and female equations, respectively. As can be seen in Table I, most of the estimated parameters have a significant influence on unemployment for males and females in the hypothesized manner. For the male equation only three variables, population density, the young age group, and the dummy variable for the Pacific division are not significant at conventional levels. Likewise in the female unemployment equation, only three variables are not significant; the population density, percent with vocational training, and the young age group. As indicated by the F-statistics, 15 of the 23 estimated coefficients are significantly different across the male and female equations. This result suggests that a specification bias would occur by combining the two groups.

Table I

DETERMINANTS OF URBAN UNEMPLOYMENT: 1970
SEEMINGLY UNRELATED REGRESSION ESTIMATES[a]

Variable[b]	Male		Female		F-Statistic[c]
	Coeffi-cient	Standard Error	Coeffi-cient	Standard Error	
Constant	.0146*	.0025	1.3670*	.2316	32.3910*
Den	.0167	.0261	.0215	.0226	.0313
Com	.4239*	.1179	.3099*	.1049	.8522
Ed	-.0053*	.0010	-.0922**	.0790	1.1147
% VT	.0060*	.0039	-.0177	.0279	.4024
% Mfg	-.0956*	.0398	-.0326**	.0258	1.8660
% WC	-.3390*	.1494	-.9202*	.1459	11.1280*
% BLF	-.0232*	.0132	.0435*	.0128	24.0750*
Age_1	-.0968	.0905	-.0824	.0873	.0194
Age_2	.1334**	.1148	-.2411*	.1023	10.6767*
Size 1	-.0019*	.0005	-.1262*	.0336	12.8590*
Size 2	-.0018*	.0004	-.1173*	.0259	18.8013*
Size 3	-.0015*	.0004	-.0957*	.0198	21.4176*
Size 4	-.0011*	.0003	-.0627*	.0147	16.7018*
Size 5	-.0005*	.0002	-.0215**	.0134	2.4000**
Div 1	-.0013*	.0004	-.1386*	.0277	23.0856*
Div 2	-.0014*	.0003	-.1154*	.0247	20.1031*
Div 3	-.0012*	.0003	-.1103*	.0261	16.4295*
Div 4	-.0018*	.0003	-.1389*	.0238	31.2441*
Div 5	-.0009*	.0002	-.0994*	.0225	18.0739*
Div 6	-.0010*	.0003	-.1096*	.0232	20.7101*
Div 7	-.0013*	.0002	-.0941*	.0228	15.6076*
Div 9	.0002	.0002	.0581*	.0222	6.3930*

[a]See Zellner [13] for a discussion of the SUR technique.

[b]See text for definition of variables.

[c]See footnote 7 for a discussion of the F-statistic.

*Significant at one percent level; **Significant at ten percent level.

Among the nine quantitative variables in the male equation, only one variable, the percent of male labor force with vocational training, has the "wrong" sign. The results for the male equation indicate that for every one percent increase in the manufacturing employment, unemployment would be reduced by one-tenth of one percent. The greatest reduction in male unemployment could be achieved by increasing the percentage of persons employed in white collar professions. In the female unemployment equation, only the percent in the old age group and the black female labor force had the incorrect sign. Likewise, the greatest decrease in female unemployment could be achieved by increasing the percentage in white collar professions.

The addition of the population size and the region dummy variables leads to some interesting results. The technique for including the dummies involved the use of the zero-one dichotomous variable according to the classes as specified in the previous section. In order to preserve independence, the technique calls for n-1 dummies for n qualitative classes. The tests for the effect of population size excluded the class of SMSA's with the smallest population (50,000-150,000). The tests for the region effect excluded the set of SMSA's in the mountain division as defined by the Census. The use of dummies for population size effectively presents the problem of asking whether or not there is a systematic difference between the male and female unemployment rates in the smallest SMSA's as compared to each of the five

other larger population classes, in addition to that already explained by the earlier inclusion of the nine original variables.

The adjusted coefficients of determination in preliminary WLS estimates using the nine quantitative variables jumped from .74 to .77 in the male equation and from .33 to .38 in the female equation when the size dummies were included. This is, at least in part, an indication of the explanatory power added by the inclusion of the size factor. A more useful observation which can be made is that of negative relationship between city size and unemployment for both males and females as indicated by the decreasingly smaller regression coefficients as one moves from size 1 (the largest class) to size 5 (the smallest). The equation predicts without bias for the smallest size class (50,000-150,000), but for SMSA's with population greater than 150,000, the predicted unemployment rate for both males and females must be increasingly corrected downward, the larger the SMSA, in order to adjust for the size effect. Tests for significant differences between the size coefficients indicated that a majority of the ten combinations were significantly different.[5] All of the size dummies are significantly different, as indicated by the F-statistic, across the male and female equations.

The eight division dummies are designed to test for spatial effects not captured by the nine quantitative variables and the size dummies. There are eight division dummies with the excluded SMSA's being those in the mountain states. It

is only necessary to demonstrate that the unemployment in one region will not be efficiently estimated by an equation based on some other region, in order to provide evidence for the hypothesis that there is some region effect. The results in Table I indicate that the strongest regional effect is found in the South Atlantic States (Division 4) for the male and female equations (based on the size of the regression coefficient). That is, an equation designed to estimate the unemployment rate most accurately for the Mountain division, ceteris paribus, needs the greatest correction for estimates of unemployment in SMSA's in the South Atlantic states. The region dummies add significantly to the increase in explanatory power, as indicated by the $\bar{R}^2$. The $\bar{R}^2$s in the basic (using the nine quantitative variables) equation increased from .74 to .79 and from .33 to .50 in the male and female equations respectively. All of the region dummies are significantly different across equations.

IV. Summary and Conclusions

The purpose of this paper was to develop a model of the determinants of urban unemployment differentials. The model was estimated using 1970 male and female SMSA unemployment rates from the Census. Unemployment can be expected to vary across urban areas due to differing labor market characteristics and socio-demographic differences in labor supply. A substantial proportion of the variance in unemployment differentials was explained by the model. The

results, estimated using Zellner's seemingly unrelated regression technique, conformed in general to the model.

The tests for economies of scale indicated that unemployment tended to be lower in more populous SMSA's. Using a series of dummy variables, the results indicated that there exists a substantial variation in unemployment rates across geographic regions. The model presented and estimated in this paper fills the neglected gap in the urban economies literature on unemployment rate differentials.

FOOTNOTES

[1]See Goldstein and Moses [1973] for a review of the urban economics literature.

[2]See Richardson [1973] for a discussion of the relationship between city size and various economic variables. Farbman [1975] has recently presented evidence of a direct relationship between city size and income inequality using 1960 U. S. data. Vipond [1974] presents some evidence that male unemployment tends to increase and female unemployment tends to decrease with increased city size.

[3]The ideal independent variable would be the percent of the male and female labor force in these two age groups. However, no Census data are available on the female age groups for all SMSA's. The difference in older age categories reflects an expected change in female labor force behavior which occurs after the capacity to bear children has been eliminated.

[4]Since a multiplicative model is assumed and estimated in double-log form, the weighting consists of transforming the log of each variable by dividing by the square root of the appropriate population (male or female) and then applying the regression analysis. The assumption of the lack of a homoscedastic disturbance and the proposed remedy was tested using the method developed by Park [1966]. The author proposed the use of the OLS residuals to test various functional relationships between these residuals and variables specified as potential determinants of the variance in the error term. The use of the OLS residual to test for heteroscedasticity has been debated, however, Goldfield and Quant [1972] find that the Park test does reasonably well in detecting the presence of heteroscedasticity. Park suggests a non-linear form with,

$$\sigma^2_{\varepsilon_i} = \sigma^2 Z_i^{\beta} V_i \qquad (1)$$

where Z_i is any factor influencing the variance and V_i is the error term. Equation (1) can be estimated using a double log transformation and the square of the OLS residuals as an estimate of the variance. Thus

$$\ln(\varepsilon_i^*)^2 = \ln\sigma^2 + \beta_i(\ln Z_i) + V_i \qquad (2)$$

where ε_i^* is the estimated residual from the male or female OLS equation. The error term is hypothesized to vary with

the size of the population in each of the two groups (male or female).

The estimated equations are (standard errors are in parentheses):

$$\ln(\varepsilon_m^*)^2 = \underset{(.078)}{.159} - \underset{(.006)}{.010} \ln(\text{male pop}) \qquad (3)$$

$$\ln(\varepsilon_f)^2 = \underset{(.059)}{.197} - \underset{(.004)}{.012} \ln(\text{female pop}) \qquad (4)$$

Since the null hypothesis of $\beta_i = 0$ can be dismissed. the assumption of homoscedasticity can be rejected. These tests indicate that the weighting scheme should provide better estimates of the model proposed in the preceding section.

[5] See Zellner [1962] for details of the estimation technique.

[6] An appendix containing data sources, the correlation matrix, OLS and WLS results is available from the authors.

[7] The F-statistic is for a test of the hypothesis that the particular elasticity is the same across the two unemployment rates. The null hypothesis is $\beta_m = \beta_f$, where β is the regression coefficient for one of the explanatory variables and the subscripts represent male and female unemployment. This hypothesis implies one restriction: $\beta_m - \beta_f = 0$. There are 1 and 438 degrees of freedom for this test, where the latter represents the number of "free" observations from the two equations. Critical values for the F-statistic are 3.84 and 6.63 for the five and one percent levels of significance.

[8] The t-test with the null hypothesis that the coefficients for any two size variables were equal was computed as follows:

$$t = \frac{\hat{\beta}_i = \hat{\beta}_j}{\sqrt{S^2_{\beta_i} + S^2_{\beta_j} - 2\mathrm{Cov}(\beta_i \beta_j)}}$$

where $\hat{\beta}_i$ and $\hat{\beta}_j$ are the estimated parameters for any two size variables, $S^2_{\beta_i}$, $S^2_{\beta_j}$ and $\mathrm{Cov}(\beta_i \beta_j)$ are the variance and covariance for the two coefficients.

REFERENCES

Farbman, M., "The Site Distribution of Family Income in U. S. SMSAs, 1959," Review of Income and Wealth (November 1975), 217-237.

Goldfield, S. M. and R. E. Quant, Nonlinear Methods in Econometrics (Amsterdam: North-Holland, 1972).

Goldstein, G. S. and L. N. Moses, "A Survey of Urban Economics," Journal of Economic Literature (June 1973), 471-515.

Hall, R. E., "Turnover in the Labor Force," Brookings Papers on Economic Activity (3; 1972), 709-763.

_______________, "Why is the Unemployment Rate so High at Fall Employment?" Brookings Papers on Economic Activity (3; 1970), 369-410.

Metcalf, D., "Urban Unemployment in England," Economic Journal (September 1975), 578-589.

Park, R. E., "Estimation with Heteroscedastic Error Terms," Econometrica (October 1966), 888-895.

Perry, G. L., "Unemployment Flows in the U. S. Labor Market," Brookings Papers on Economic Activity (2; 1972), 245-292.

Richardson, H. W., The Economics of City Size (Lexington: Lexington Books, 1973).

Smith, R. E., J. E. Vanski, and C. C. Holt, "Recession and the Employment of Demographic Groups," Brookings Papers on Economic Activity (3; 1974), 737-750.

Sorkin, A. L., Education, Unemployment, and Economic Growth (Lexington: Lexington Books, 1974).

Vipond, J., "City Size and Unemployment," Urban Studies (June 1974), 39-46.

Zellner, A., "An Efficient Method of Estimating Seemingly Unrelated Regressions and Tests for Aggregation Bias," JASA (June 1962), 348-368.